PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-018737
(43)Date of publication of application : 18.01.2000

(51)Int.Cl. F25B 1/00

(21)Application number : 10-177054
(22)Date of filing : 24.06.1998

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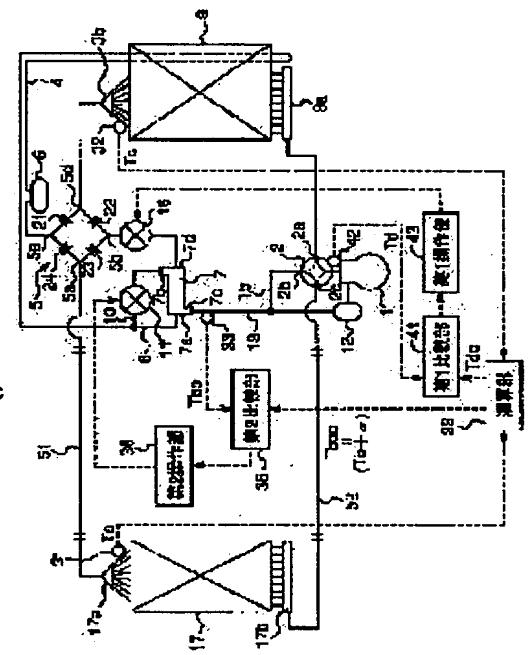
(54) AIR-CONDITIONER

(57)Abstract:
PROBLEM TO BE SOLVED: To accurately control the degree of superheating of a bypass flow refrigerant while suppressing costs.
SOLUTION: In an air-conditioner, degree-of-superheating control parts 33, 35, and 36 adjust the amount of constriction of a bypass-side automated expansion valve 11 so that a value (Te-Tbo) that is obtained by subtracting a refrigerant temperature Te being detected by a temperature sensor 31 at the entrance of an indoor heat exchanger (evaporator) 17 from a refrigerant temperature Tbo at a bypass outlet 7c of a heat exchanger 7 for supercooling reaches a specific value of α on cooling. Therefore, a temperature sensor at an inlet 7b of the heat exchanger 7 for supercooling that has been required conventionally becomes unnecessary, thus accurately controlling the degree of superheating of the bypass flow refrigerant while reducing cost.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] The main circuit which pours a refrigerant in order of a compressor (1), a condenser (3 17), the heat exchanger for supercooling (7), the main electric expansion valve (16), and an evaporator (17 3), It branches from the above-mentioned main circuit between the above-mentioned condenser and the main electric expansion valve. A bypass side electric expansion valve (11), The mainstream refrigerant which is equipped with the refrigerant circuit which has the bypass circuit which joins the above-mentioned main circuit by the inlet side of a sink and the above-mentioned compressor (1) in a refrigerant in order of the above-mentioned heat exchanger for supercooling (7), and flows the above-mentioned main circuit, Heat exchange is performed between the bypass style refrigerants which flow the above-mentioned bypass circuit. Are the air conditioner which supercools the above-mentioned mainstream refrigerant, and it is based on the coolant temperature (Te, Tc) in the above-mentioned evaporator (17 3) inlet port (17a, 3b), and the coolant temperature (Tbo) in the outlet (7c) of the above-mentioned heat exchanger for supercooling (7). The air conditioner characterized by having adjusted the amount of drawing of the above-mentioned bypass side electric expansion valve (11), and having the degree-of-superheat control section (33, 35, 36) which makes the degree of superheat of the bypass side outlet (7c) of the above-mentioned heat exchanger for supercooling (7) a target degree of superheat.
[Claim 2] In an air conditioner according to claim 1 the above-mentioned degree-of-superheat control section (33, 35, 36) So that the temperature gradient (Tbo-Te, Tbo-Tc) which subtracted the coolant temperature (Te, Tc) in the above-mentioned evaporator inlet port (17a, 3b) from the coolant temperature (Tbo) in the outlet (7c) of the above-mentioned heat exchanger for supercooling (7) may become predetermined desired value (alpha, beta) The air conditioner characterized by adjusting the amount of drawing of the above-mentioned bypass side electric expansion valve (11).
[Claim 3] In an air conditioner according to claim 1 the above-mentioned degree-of-superheat control section (33, 35, 36) So that the value (Te+alpha, Tc+beta) which added constant value (alpha, beta) to the coolant temperature (Te, Tc) in the above-mentioned evaporator inlet port (17a, 3b) may become a coolant temperature (Tbo) in the outlet (7c) of the above-mentioned heat exchanger for supercooling (7) The air conditioner characterized by adjusting the amount of drawing of the above-mentioned bypass side electric expansion valve (11).
[Claim 4] In claim 1 thru/or the air conditioner of any one publication of three at the time of air conditioning While pouring the refrigerant from an outdoor heat exchanger (3) to the heat exchanger for supercooling (7), the main electric expansion valve (16), and indoor heat exchanger (17), one by one at the time of heating The air conditioner characterized by having the check valve bridge rectifier circuit (5) which pours the refrigerant from indoor heat exchanger (17) one by one to the heat exchanger for supercooling (7), the main electric expansion valve (16), and an outdoor heat exchanger (3).

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to an air conditioner. It is related with the air conditioner equipped with the refrigerant circuit which performs heat exchange between a mainstream refrigerant and a bypass style refrigerant, and supercools a mainstream refrigerant in more detail.
[0002]
[Description of the Prior Art] As shown in drawing 5 , as a refrigerant circuit 301 of this kind of air conditioner The main circuit 306 which has a compressor 302, a condenser 303, the double pipe exchanger 310 for supercooling, the main electric expansion valve 304, an evaporator 305, the 4 way change-over valve 309, and an accumulator 308 in this order, It branches from a main circuit 306 at the branch point 341 between the above-mentioned condenser 303 and the heat exchanger 310 for supercooling. It passes along the bypass electric expansion valve 312 and the heat exchanger 310 for supercooling, and the thing including the bypass circuit (a broken line shows) 313 which joins a main circuit 306 in the juncture 342 near the inlet port of the above-mentioned accumulator 308 is known.
[0003] The refrigerant breathed out from the compressor 302 is condensed by the condenser (for example, heat is radiated to outdoor air) 303, and separates to the mainstream refrigerant which flows a main circuit 306 at a junction 341, and the bypass style refrigerant which flows the bypass circuit 313. In the heat exchanger 310 for supercooling, after this mainstream refrigerant is supercooled by heat exchange with the above-mentioned bypass style refrigerant after bypass electric expansion valve 312 passage, it is decompressed by the main electric expansion valve 304. And a mainstream refrigerant evaporates with an evaporator (for example, it carries out endoergic from indoor air) 305, and is absorbed by the compressor 302 through the accumulator 308 which performs the 4 way change-over valve 309 and vapor liquid separation. On the other hand, after a bypass style refrigerant passes the above-mentioned bypass electric expansion valve 312 and is decompressed, it evaporates by heat exchange with a mainstream refrigerant in the heat exchanger 310 for supercooling. Then, a bypass style refrigerant joins a mainstream refrigerant in the juncture 342 near the inlet port of an accumulator 308.
[0004] Thus, by supercooling a mainstream refrigerant by the heat exchanger 310 for supercooling, the refrigerating effect by the mainstream refrigerant can be increased as compared with the case where supercooling is not performed. The flow rate of a mainstream refrigerant and a bypass style refrigerant is adjusted by changing the amount of drawing of the main electric expansion valve 304.
[0005] At the time of operation, the temperature sensor 332 of the outlet of a condenser 303 detects the outlet temperature Tc of a condenser 303, and the temperature sensor 333 of the inlet port of an evaporator 305 detects the inlet temperature Te of an evaporator 305. And target temperature Td(target) =f (Te, Tc) of a compressor outlet is set up as a function f of the

outlet temperature Tc of a condenser 303, and the inlet temperature Te of an evaporator 305. On the other hand, the temperature sensor 331 of the outlet (discharge tube) of a compressor 302 detects the actual discharge-tube temperature Td. And the difference (Td-Td (target)) of the actual discharge-tube temperature Td and the target temperature Td (target) is computed, and the amount of drawing of the main electric expansion valve 304 is adjusted so that this difference (Td-Td (target)) may serve as zero. With this, the temperature sensor 335 of the bypass side outlet of the heat exchanger 310 for supercooling detects the bypass side outlet temperature Tbo, and the temperature sensor 334 of the bypass side entrance of the heat exchanger 310 for supercooling detects the bypass side entrance temperature (temperature of the bypass style refrigerant passing through this bypass side entrance) Tbi. And the difference (Tbo-Tbi) of the bypass side outlet temperature Tbo and the bypass side entrance temperature Tbi is computed, and the bypass electric expansion valve 312 is controlled so that this difference (Tbo-Tbi) becomes predetermined desired value.
[0006] The degree of superheat of the bypass style refrigerant which passes along the bypass side outlet of the degree of superheat of the mainstream refrigerant passing through the outlet of an evaporator 305 and the heat exchanger 310 for supercooling by this is exactly controllable. Therefore, the advantage which performs supercooling can fully be employed efficiently and high refrigerating capacity can be maintained irrespective of a service condition.
[0007] As shown in drawing 4 as one example, the above-mentioned temperature gradient (Tbo-Tbi) becomes so large that the opening of the main electric expansion valve 304 is large, and becomes so small that the opening of the bypass electric expansion valve 312 is large. And the engine-performance peak point P1 has a temperature gradient (Tbo-Tbi) in the point on the curve which is about 3 degrees C. Moreover, the field R1 where capacity and COP become 99% or more of the engine-performance peak point P1 turns into an ellipse field which includes the engine-performance peak point P1. The temperature gradient (Tbo-Tbi) continues and exists in the 15-degree C curve from the curve which is 3 degrees C, and this ellipse field R1 has extended in the direction which opens the side Rika main electric expansion valve 304 in which a 3 degrees C - 15 degrees C curvilinear group begins to spread, and the bypass electric expansion valve 312.
[0008]
[Problem(s) to be Solved by the Invention] By the way, in the above-mentioned conventional example, since temperature sensors 334 and 335 are needed for the bypass side entrance and outlet of the heat exchanger 310 for supercooling, there is a problem of becoming a cost rise.
[0009] Then, the purpose of this invention is to offer the air conditioner which can control the degree of superheat of a bypass style refrigerant exactly, holding down cost.
[0010]
[Means for Solving the Problem] As the artificer of this invention etc. showed drawing 2 R> 2, the curve from which the difference (Tbo-Te) of the bypass side outlet temperature Tbo and the evaporator inlet temperature Te becomes 3 degrees C, 4 degrees C, 6 degrees C, 8 degrees C, 10 degrees C, and 15 degrees C discovered that it was close to the curve from which the above-mentioned temperature gradient (Tbo-Tbi) becomes 3 degrees C, 4 degrees C, 6 degrees C, 8 degrees C, 10 degrees C and 15 degrees C, respectively. The curvilinear group of drawing 4 approached the curvilinear group of drawing 2 , and the above-mentioned temperature gradient found out that both the curvilinear group carried out abbreviation coincidence above 8 degrees C, so that the above-mentioned temperature gradient (Tbo-Tbi) became larger than 3 degrees C especially. From this, based on the coolant temperature Te in an evaporator inlet port, and the coolant temperature Tbo in the outlet of the heat exchanger for supercooling, the artificer etc. thought that it became abbreviation equivalence to adjust the amount of drawing of a bypass side electric expansion valve adjusting the amount of drawing of a bypass side electric expansion valve based on the coolant temperature Tbi in the inlet port of the heat exchanger for supercooling, and the coolant temperature Tbo in the outlet of the heat exchanger for supercooling, and created this invention.
[0011] Namely, the air conditioner of invention of this claim 1 The main circuit which pours a refrigerant in order of a compressor, a condenser, the heat exchanger for supercooling, the main

electric expansion valve, and an evaporator, It branches from the above-mentioned main circuit between the above-mentioned condenser and the main electric expansion valve. A bypass side electric expansion valve, The mainstream refrigerant which is equipped with the refrigerant circuit which has the bypass circuit which joins the above-mentioned main circuit by the inlet side of a sink and the above-mentioned compressor in a refrigerant in order of the above-mentioned heat exchanger for supercooling, and flows the above-mentioned main circuit, Heat exchange is performed between the bypass style refrigerants which flow the above-mentioned bypass circuit. Are the air conditioner which supercools the above-mentioned mainstream refrigerant, and the amount of drawing of the above-mentioned bypass side electric expansion valve is adjusted based on the coolant temperature in the above-mentioned evaporator inlet port, and the coolant temperature in the outlet of the above-mentioned heat exchanger for supercooling. It is characterized by having the degree-of-superheat control section which makes the degree of superheat of the bypass side outlet of the above-mentioned heat exchanger for supercooling a target degree of superheat.

[0012] In invention of this claim 1, based on the coolant temperature in an evaporator inlet port, and the coolant temperature in the outlet of the heat exchanger for supercooling, a degree-of-superheat control section adjusts the amount of drawing of a bypass side electric expansion valve, and makes the degree of superheat of the bypass side outlet of the heat exchanger for supercooling a target degree of superheat. Therefore, according to this invention, there is no need of installing a temperature sensor in the inlet port of the heat exchanger for supercooling, a temperature sensor is formed in the outlet of the heat exchanger for supercooling, and the coolant temperature in an evaporator inlet port can divert and detect the temperature sensor used for detection of the various operational status of an air conditioner, and control. Therefore, according to invention of claim 1, the degree of superheat of a bypass style refrigerant is exactly controllable, holding down cost, since the temperature sensor in the inlet port of the heat exchanger for supercooling which was the need conventionally becomes unnecessary.

[0013] Moreover, as for invention of claim 2, the temperature gradient (Tbo-Te) to which the above-mentioned degree-of-superheat control means subtracted the coolant temperature Te in the above-mentioned evaporator inlet port from the coolant temperature Tbo in the outlet of the above-mentioned heat exchanger for supercooling in the air conditioner according to claim 1 is characterized by adjusting the amount of drawing of the above-mentioned bypass side electric expansion valve so that it may become predetermined desired value.

[0014] In invention of this claim 2, a degree-of-superheat control means adjusts the amount of drawing of a bypass side electric expansion valve, and makes a temperature gradient (Tbo-Te) predetermined desired value. as mentioned above, capacity and COP -- the relation between 99% or more of field of a peak point, and a temperature gradient (Tbo-Te) -- capacity and COP -- the relation between 99% or more of field of a peak point, and a temperature gradient (Tbo-Tbi), and abbreviation -- it is equal.

[0015] Therefore, according to invention of this claim 2, the degree of superheat of a bypass style refrigerant is exactly controllable by adopting a temperature gradient (Tbo-Te) as the criteria which set up the amount of drawing of a bypass side electric expansion valve as usual, suppressing a cost rise without installing a temperature sensor in the inlet port of the heat exchanger for supercooling.

[0016] Moreover, as for invention of claim 3, the value to which the above-mentioned degree-of-superheat control means added constant value to the coolant temperature in the above-mentioned evaporator inlet port in the air conditioner according to claim 1 is characterized by adjusting the amount of drawing of the above-mentioned bypass side electric expansion valve so that it may become a coolant temperature in the outlet of the above-mentioned heat exchanger for supercooling.

[0017] In invention of this claim 3, a degree-of-superheat control means adjusts the amount of drawing of a bypass side electric expansion valve, and makes the coolant temperature in the outlet of the heat exchanger for supercooling the value which added constant value to the coolant temperature in an evaporator inlet port. Thereby, capacity and COP are brought close to an engine-performance peak point, and improvement in capacity and COP can be aimed at.

[0018] Moreover, in invention of claim 4, in claim 1 thru/or the air conditioner of any one publication of three, while pouring the refrigerant from an outdoor heat exchanger one by one to the heat exchanger for supercooling, the main electric expansion valve, and indoor heat exchanger at the time of air conditioning, it is characterized by having the check valve bridge rectifier circuit which pours the refrigerant from indoor heat exchanger one by one to the heat exchanger for supercooling, the main electric expansion valve, and an outdoor heat exchanger at the time of heating.
[0019] In invention of this claim 4, the refrigerant from an outdoor heat exchanger is poured by the above-mentioned rectifier circuit in order of the heat exchanger for supercooling, the main electric expansion valve, and indoor heat exchanger at the time of air conditioning. On the other hand, at the time of heating, the above-mentioned rectifier circuit pours the refrigerant from indoor heat exchanger in order of the heat exchanger for supercooling, the main electric expansion valve, and an outdoor heat exchanger. Therefore, according to invention of this claim 4, in both air conditioning and heating, the heat exchanger for supercooling is used and improvement in capacity and COP can be aimed at.
[0020]
[Embodiment of the Invention] Hereafter, the gestalt of implementation of illustration explains this invention to a detail.
[0021] The circuit of the gestalt of operation of the air conditioner of this invention is shown in drawing 1 . This operation gestalt has the check valve bridge 5 connected to shunt 3b of a compressor 1, 4 way selector valve 2 connected to the discharge side of this compressor 1, the outdoor heat exchanger 3 by which header 3a was connected to opening 2a of this 4 way selector valve 2, and this outdoor heat exchanger 3. This check valve bridge 5 consists of four check valves 21, 22, 23, and 24 by which closed-loop connection was made.
[0022] Via a receiver 6, terminal 5a of this check valve bridge 5 makes a U-turn, after penetrating the inside of an outdoor heat exchanger 3, it penetrates an outdoor heat exchanger 3 again, and is connected to mainstream side entrance 7a of the supercooling heat exchanger 7 by the detour piping 4. It is for carrying out the seal (seal) of the refrigerant in front of the supercooling heat exchanger 7 to pass a receiver 6 and an outdoor heat exchanger 3 in front of the supercooling heat exchanger 7 as the detour piping 4 is also about a refrigerant.
[0023] And the branch line 10 which branches before the above-mentioned mainstream side entrance 7a is connected to the piping 8 which connects terminal 5a of the above-mentioned check valve bridge 5 to mainstream side entrance 7a of the supercooling heat exchanger 7. This branch line 10 is connected to bypass side entrance 7b of the supercooling heat exchanger 7 via the bypass side electric expansion valve 11. Moreover, bypass side outlet 7c of this supercooling heat exchanger 7 is piping 13, and is connected to the inlet side of a compressor 1 via the accumulator 12. Piping 15 is connected to this piping 13 before the above-mentioned accumulator 12, and this piping 15 is connected to opening 2b of 4 way selector valve 2.
[0024] On the other hand, 7d of mainstream side outlets of the above-mentioned supercooling heat exchanger 7 is connected to the Maine electric expansion valve 16, and this Maine electric expansion valve 16 is connected to terminal 5b of the check valve bridge 5. And terminal 5c of this check valve bridge 5 is connected to shunt 17a of indoor heat exchanger 17. Header 17b of this indoor heat exchanger 17 is connected to opening 2c of 4 way selector valve 2.
[0025] Moreover, as for this air conditioner, the temperature sensor 31 is attached in shunt 17a of indoor heat exchanger 17. Moreover, the temperature sensor 32 is attached in shunt 3b of an outdoor heat exchanger 3. The signal from temperature sensors 31 and 32 is sent to operation part 33. This operation part 33 outputs the value (Te+alpha) which added the predetermined temperature alpha to the temperature Te which the temperature sensor 31 detected to the 2nd comparator 35 as desired value Tboo of the coolant temperature Tbo in bypass side outlet 7c of the supercooling heat exchanger 7. This 2nd comparator 35 compares the temperature Tbo and desired value Tboo which the signal sent from the temperature sensor 33 attached in bypass side outlet 7c of the supercooling heat exchanger 7 expresses, and sends out the signal showing the opening of the bypass electric expansion valve 11 from which the measurement temperature Tbo becomes desired value Tboo to the 2nd control unit 36. This 2nd control unit 36 adjusts the

opening of the bypass side electric expansion valve 11 according to the signal showing the above-mentioned opening.

[0026] Furthermore, from the signal showing the temperature Te from a temperature sensor 31, and the signal showing the temperature Tc from a temperature sensor 32, the above-mentioned operation part 33 calculates the desired value Tdo of the discharge-tube temperature Td of a compressor 1, and outputs it to the 1st comparator 41. This 1st comparator 41 receives the signal showing the discharge-tube temperature Td from the temperature sensor 42 attached in the discharge tube of a compressor 1, measures the above-mentioned desired value Tdo and the actual discharge-tube temperature Td, and outputs this compared result to the 1st control unit 43. Based on the above-mentioned comparison result, this 1st control unit 43 adjusts the opening of the Maine electric expansion valve 16 so that the discharge-tube temperature Td may become desired value Tdo.

[0027] The air conditioner of the above-mentioned configuration performs air conditioning operation, while 4 way selector valve 2 is making the continuous-line path shown in drawing 1 open for free passage. In this air conditioning operation, the refrigerant which the compressor 1 breathed out is sent out to an outdoor heat exchanger 3, and is condensed by this outdoor heat exchanger 3. This condensed refrigerant passes along the check valve 21 of the check valve bridge 5, passes a receiver 6 and an outdoor heat exchanger 3, passes along piping 8, and flows into mainstream side entrance 7a of the supercooling heat exchanger 7. The mainstream refrigerant which flowed into this supercooling heat exchanger 7 branches from the mainstream by the branch line 10, and heat exchange of it is carried out to the refrigerant which expanded and got cold in the bypass side electric expansion valve 11, and it is cooled. Next, after this cooled mainstream refrigerant expands and gets cold in the Maine electric expansion valve 16, it passes along the check valve 23 of the check valve bridge 5, and flows into indoor heat exchanger 17. The refrigerant which flowed into this indoor heat exchanger 17 cools indoor air at the same time it evaporates, it passes along 4 way selector valve 2, joins in the style of [of piping 13] a bypass refrigerant through piping 15, and flows into the inlet side of a compressor 1.

[0028] On the other hand, while 4 way selector valve 2 is making the broken-line path shown in drawing 1 open for free passage, this air conditioner performs heating operation. In this heating operation, the refrigerant which the compressor 1 breathed out is sent out to indoor heat exchanger 17, is condensed by this indoor heat exchanger 17, and radiates heat indoors. This condensed refrigerant passes along the check valve 24 of the check valve bridge 5, passes a receiver 6 and an outdoor heat exchanger 3, passes along piping 8, and flows into mainstream side entrance 7a of the supercooling heat exchanger 7. Heat exchange of the mainstream refrigerant which flowed into this supercooling heat exchanger 7 is carried out to the refrigerant which branched from the mainstream by the branch line 10, and expanded by the bypass side electric expansion valve 11, and it is cooled. Next, after this cooled mainstream refrigerant expands and gets cold in the Maine electric expansion valve 16, it passes along the check valve 22 of the check valve bridge 5, and flows into an outdoor heat exchanger 3. Endoergic [of the refrigerant which flowed into this outdoor heat exchanger 3] is carried out, it evaporates, joins in the style of [of piping 13] a bypass refrigerant through 4 way selector valve 2 and piping 15, and flows into the inlet side of a compressor 1.

[0029] Thus, according to this operation gestalt, also at the time of air conditioning, a refrigerant is poured in order of the supercooling heat exchanger 7 and the Maine electric expansion valve 16 from the outdoor heat exchanger 3 or indoor heat exchanger 17 as a condenser as work of the check valve bridge 5 is also also at the time of heating, the supercooling heat exchanger 7 is used, and capacity and COP can be improved.

[0030] Moreover, according to this operation gestalt, the value (Te+alpha) which added the predetermined temperature alpha to the temperature Te which the temperature sensor 31 installed in the inlet port of the indoor heat exchanger 17 which works as an evaporator detected at the time of air conditioning was made into the desired value Tboo of the coolant temperature Tbo in bypass side outlet 7c of the supercooling heat exchanger 7. And the opening of the bypass side electric expansion valve 11 is adjusted so that the coolant temperature Tbo which

the temperature sensor 33 attached in bypass side outlet 7c of the supercooling heat exchanger 7 detected may be made into this desired value Tboo.
[0031] The value (Tc+beta) which added the predetermined temperature beta to the temperature Tc which the temperature sensor 32 installed in the inlet port of the outdoor heat exchanger 3 which works as an evaporator detected on the other hand at the time of heating was made into the desired value Tboo of the coolant temperature Tb in bypass side outlet 7c of the supercooling heat exchanger 7. And the opening of the bypass side electric expansion valve 11 is adjusted so that the coolant temperature Tbo which the temperature sensor 33 attached in bypass side outlet 7c of the supercooling heat exchanger 7 detected may be made into this desired value Tboo.
[0032] According to such supercooling control, holding down cost, since the temperature sensor of the inlet port of the heat exchanger 7 for supercooling which was the need conventionally becomes unnecessary, the degree of superheat of a bypass style refrigerant can be controlled exactly, and improvement in capacity and COP can be aimed at.
[0033] Next, a refrigerant condition when the interunit piping 51 and 52 between indoor heat exchanger 17 and an outdoor heat exchanger 3 is long (20m) is shown in the Mollier chart of drawing 3 as a continuous line, and a refrigerant condition when the above-mentioned interunit piping 51 and 52 is short (5m) is shown in it with a broken line. The coolant temperature Tbo (5m) in bypass side outlet 7c in the case of 5m piping is high compared with the coolant temperature Tbo (20m) in bypass side outlet 7c in the case of 20m piping so that it may understand, if drawing 3 is referred to. And a coolant temperature Tbo (20m) is closer to the coolant temperature Te in the inlet port of indoor heat exchanger 17 than a coolant temperature Tbo (5m).
[0034] Therefore, if interunit piping is changed into 20m piping in the condition that the desired value Tboo of a coolant temperature Tbo (5m) is set as (Te+alpha) in the refrigerant circuit of 5m piping, a coolant temperature Tbo will fall. If another view is carried out and 5m piping will be changed into 20m piping, it will shift in the direction which the bypass electric expansion valve 11 closes like the time of raising desired value Tboo in 5m piping. Consequently, it will shift in the direction which overheating by bypass side outlet 7c attaches, and the engine performance shown in drawing 2 and COP cannot deviate from 99% of field R1 of maximum easily. Because, as shown in drawing 2 , the temperature gradient to the direction where overheating is attached is from it being steep (the constant-temperature line being crowded). And there is almost no effect which gives it to expansion valve opening control at about 2 degrees C since the difference of a coolant temperature Tbo (5m) and a coolant temperature Tbo (20m) is comparatively small. In addition, it sets to an overheating side (that is, a temperature gradient (Tbo-Te) elevated-temperature side (for example, 4 degrees C)) a little practically rather than the engine-performance peak point P1 illustrated to drawing 2 . As shown in drawing 2 , even if a temperature gradient (Tbo-Te) becomes 8 degrees C and 10 degrees C, the degradation from the engine-performance peak point P1 is small (less than 1%).
[0035] In addition, although controlled by the gestalt of the above-mentioned implementation to set Tbo to =(Te+ predetermined value alpha) Tboo, you may control so that (Tbo-Te) becomes a predetermined value.
[0036]
[Effect of the Invention] As mentioned above, in the air conditioner of invention of this claim 1, based on the coolant temperature in an evaporator inlet port, and the coolant temperature in the outlet of the heat exchanger for supercooling, a degree-of-superheat control section adjusts the amount of drawing of a bypass side electric expansion valve, and makes the degree of superheat of the bypass side outlet of the heat exchanger for supercooling a target degree of superheat so that clearly. Therefore, according to this invention, there is no need of installing a temperature sensor in the inlet port of the heat exchanger for supercooling, a temperature sensor is formed in the outlet of the heat exchanger for supercooling, and the coolant temperature in an evaporator inlet port can divert and detect the temperature sensor used for detection of the various operational status of an air conditioner, and control. Therefore, according to invention of claim 1, the degree of superheat of a bypass style refrigerant is exactly controllable, holding

down cost, since the temperature sensor in the inlet port of the heat exchanger for supercooling which was the need conventionally becomes unnecessary.

[0037] Moreover, in invention of claim 2, a degree-of-superheat control means adjusts the amount of drawing of a bypass side electric expansion valve, and makes a temperature gradient (Tbo-Te) predetermined desired value. as mentioned above, capacity and COP -- the relation between 99% or more of field of a peak point, and a temperature gradient (Tbo-Te) -- capacity and COP -- the relation between 99% or more of field of a peak point, and a temperature gradient (Tbo-Tbi), and abbreviation -- it is equal. Therefore, according to invention of this claim 2, the degree of superheat of a bypass style refrigerant is exactly controllable by adopting a temperature gradient (Tbo-Te) as the criteria which set up the amount of drawing of a bypass side electric expansion valve as usual, suppressing a cost rise without installing a temperature sensor in the inlet port of the heat exchanger for supercooling.

[0038] Moreover, in invention of claim 3, a degree-of-superheat control means adjusts the amount of drawing of a bypass side electric expansion valve, and makes the coolant temperature in the outlet of the heat exchanger for supercooling the value which added constant value to the coolant temperature in an evaporator inlet port. Thereby, capacity and COP are brought close to an engine-performance peak point, and improvement in capacity and COP can be aimed at.

[0039] Moreover, in invention of claim 4, the refrigerant from an outdoor heat exchanger is poured by the check valve bridge rectifier circuit in order of the heat exchanger for supercooling, the main electric expansion valve, and indoor heat exchanger at the time of air conditioning. On the other hand, at the time of heating, the above-mentioned rectifier circuit pours the refrigerant from indoor heat exchanger in order of the heat exchanger for supercooling, the main electric expansion valve, and an outdoor heat exchanger. Therefore, according to invention of this claim 4, in both air conditioning and heating, the heat exchanger for supercooling is used and improvement in capacity and COP can be aimed at.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram showing the configuration of the gestalt of operation of the air conditioner of this invention.

[Drawing 2] In the gestalt of the above-mentioned implementation, it is the property Fig. showing the relation between the opening of a Maine electric expansion valve and a bypass side electric expansion valve, and the degree of superheat (Tbo-Te) of a supercooling heat exchanger.

[Drawing 3] It is a Mollier chart explaining actuation of the gestalt of the above-mentioned implementation.

[Drawing 4] In the gestalt of the above-mentioned implementation, it is the property Fig. showing the relation between the opening of a Maine electric expansion valve and a bypass side electric expansion valve, and the degree of superheat (Tbo-Tbi) of a supercooling heat exchanger.

[Drawing 5] It is the refrigerant circuit Fig. of the conventional air conditioner. It is drawing.

[Description of Notations]
1 [-- A header, 5 / -- A check valve bridge, 6 / -- A receiver, 7 / -- A supercooling heat exchanger, 7a / -- A mainstream side entrance, 7b / -- A bypass side entrance, 7c / -- A bypass side outlet, 7d / -- A mainstream side outlet, 11 / -- A bypass side electric expansion valve 16 -- A Maine electric expansion valve, 17 / -- Indoor heat exchanger,, 31, 32, 33, 34 -- Temperature sensor.] -- A compressor, a 2 --4 way selector valve, 3 -- An outdoor heat exchanger, 3a -- A shunt, 3b

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[Translation done.]

(19)日本国特許庁（ＪＰ）

(12) 公開特許公報（Ａ）

(11)特許出願公開番号
特開2000－18737
（P2000－18737A）

(43)公開日 平成12年1月18日(2000.1.18)

(51)Int.Cl.⁷	識別記号	ＦＩ		テーマコード（参考）
Ｆ２５Ｂ 1/00	３３１	Ｆ２５Ｂ 1/00	３３１Ｅ	

審査請求 未請求 請求項の数４ ＯＬ （全 ７ 頁）

(21)出願番号 特願平10－177054

(22)出願日 平成10年6月24日(1998.6.24)

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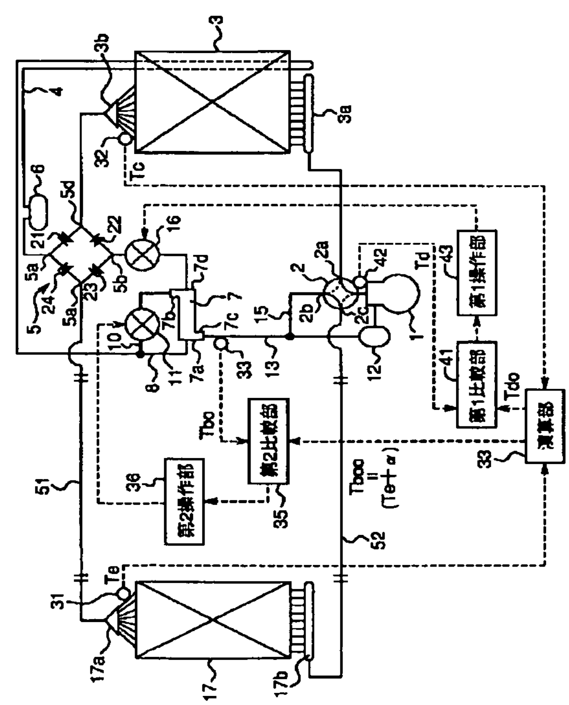
(54)【発明の名称】 空気調和機

(57)【要約】

【課題】 コストを抑えながら、バイパス流冷媒の過熱度を的確に制御できる空気調和機を提供する。

【解決手段】 この空気調和機では、過熱度制御部(33，35，36)は、冷房時に、過冷却用熱交換器７のバイパス出口７ｃでの冷媒温度Ｔｂｏから、室内熱交換器(蒸発器)１７の入口で温度センサ３１が検知した冷媒温度Ｔｅを減算した値(Ｔｅ－Ｔｂｏ)が所定値αになるように、バイパス側電動膨張弁１１の絞り量を調節する。したがって、従来必要であった過冷却用熱交換器７の入口７ｂでの温度センサが不要になるから、コストを抑えながら、バイパス流冷媒の過熱度を的確に制御できる。



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【特許請求の範囲】

【請求項１】　圧縮機(１)、凝縮器(３，１７)、過冷却用熱交換器(７)、主電動膨張弁(１６)および蒸発器(１７，３)の順に冷媒を流す主回路と、上記凝縮器と主電動膨張弁との間で上記主回路から分岐して、バイパス側電動膨張弁(１１)、上記過冷却用熱交換器(７)の順に冷媒を流し、上記圧縮機(１)の吸入側で上記主回路と合流するバイパス回路とを有する冷媒回路を備えて、上記主回路を流れる主流冷媒と、上記バイパス回路を流れるバイパス流冷媒との間で熱交換を行って、上記主流冷媒を過冷却する空気調和機であって、

上記蒸発器(１７，３)入口(１７ａ，３ｂ)での冷媒温度(Ｔｅ，Ｔｃ)と上記過冷却用熱交換器(７)の出口(７ｃ)での冷媒温度(Ｔｂｏ)とに基づいて、上記バイパス側電動膨張弁(１１)の絞り量を調節して、上記過冷却用熱交換器(７)のバイパス側出口(７ｃ)の過熱度を、目標過熱度にする過熱度制御部(３３，３５，３６)を備えたことを特徴とする空気調和機。

【請求項２】　請求項１に記載の空気調和機において、上記過熱度制御部(３３，３５，３６)は、上記過冷却用熱交換器(７)の出口(７ｃ)での冷媒温度(Ｔｂｏ)から上記蒸発器入口(１７ａ，３ｂ)での冷媒温度(Ｔｅ，Ｔｃ)を減算した温度差(Ｔｂｏ－Ｔｅ，Ｔｂｏ－Ｔｃ)が所定の目標値(α，β)になるように、上記バイパス側電動膨張弁(１１)の絞り量を調節することを特徴とする空気調和機。

【請求項３】　請求項１に記載の空気調和機において、上記過熱度制御部(３３，３５，３６)は、上記蒸発器入口(１７ａ，３ｂ)での冷媒温度(Ｔｅ，Ｔｃ)に一定値(α，β)を加算した値(Ｔｅ＋α，Ｔｃ＋β)が上記過冷却用熱交換器(７)の出口(７ｃ)での冷媒温度(Ｔｂｏ)になるように、上記バイパス側電動膨張弁(１１)の絞り量を調節することを特徴とする空気調和機。

【請求項４】　請求項１乃至３のいずれか1つに記載の空気調和機において、

冷房時には、室外熱交換器(３)からの冷媒を、順次、過冷却用熱交換器(７)、主電動膨張弁(１６)、室内熱交換器(１７)に流す一方、暖房時には、室内熱交換器(１７)からの冷媒を、順次、過冷却用熱交換器(７)、主電動膨張弁(１６)、室外熱交換器(３)に流す逆止弁ブリッジ整流回路(５)を備えたことを特徴とする空気調和機。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は、空気調和機に関する。より詳しくは、主流冷媒とバイパス流冷媒との間で熱交換を行って主流冷媒を過冷却する冷媒回路を備えた空気調和機に関する。

【０００２】

【従来の技術】図５に示すように、この種の空気調和機の冷媒回路３０１としては、圧縮機３０２、凝縮器３０

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３、過冷却用の二重管式熱交換器３１０、主電動膨張弁３０４、蒸発器３０５、四路切換弁３０９およびアキュムレータ３０８をこの順に有する主回路３０６と、上記凝縮器３０３と過冷却用熱交換器３１０との間の分岐点３４１で主回路３０６から分岐して、バイパス電動膨張弁３１２と過冷却用熱交換器３１０とを通り、上記アキュムレータ３０８の入口近傍の合流点３４２で主回路３０６と合流するバイパス回路（破線で示す）３１３とを含むものが知られている。

【０００３】圧縮機３０２から吐出された冷媒は、凝縮器（例えば室外空気に放熱する）３０３によって凝縮され、分岐点３４１で主回路３０６を流れる主流冷媒とバイパス回路３１３を流れるバイパス流冷媒とに別れる。この主流冷媒は、過冷却用熱交換器３１０において、バイパス電動膨張弁３１２通過後の上記バイパス流冷媒との熱交換によって過冷却された後、主電動膨張弁３０４によって減圧される。そして、主流冷媒は、蒸発器（例えば室内空気から吸熱する）３０５によって蒸発され、四路切換弁３０９および気液分離を行うアキュムレータ３０８を通して圧縮機３０２に吸い込まれる。一方、バイパス流冷媒は、上記バイパス電動膨張弁３１２を通過して減圧された後、過冷却用熱交換器３１０において主流冷媒との熱交換によって蒸発される。この後、バイパス流冷媒は、アキュムレータ３０８の入口近傍の合流点３４２で主流冷媒と合流する。

【０００４】このように過冷却用熱交換器３１０で主流冷媒を過冷却することにより、過冷却を行わない場合に比して主流冷媒による冷凍効果を増大できる。主流冷媒とバイパス流冷媒の流量は、主電動膨張弁３０４の絞り量を変化させることによって調整されている。

【０００５】運転時には、凝縮器３０３の出口の温度センサ３３２によって凝縮器３０３の出口温度Ｔｃを検出し、蒸発器３０５の入口の温度センサ３３３によって蒸発器３０５の入口温度Ｔｅを検出する。そして、凝縮器３０３の出口温度Ｔｃと蒸発器３０５の入口温度Ｔｅとの関数ｆとして、圧縮機出口の目標温度Ｔｄ（target）＝ｆ（Ｔｅ，Ｔｃ）を設定する。一方、圧縮機３０２の出口（吐出管）の温度センサ３３１によって、実際の吐出管温度Ｔｄを検出する。そして、実際の吐出管温度Ｔｄと目標温度Ｔｄ（target）との差（Ｔｄ－Ｔｄ（target））を算出し、この差（Ｔｄ－Ｔｄ（target））がゼロとなるように、主電動膨張弁３０４の絞り量を調整する。これとともに、過冷却用熱交換器３１０のバイパス側出口の温度センサ３３５によってバイパス側出口温度Ｔｂｏを検出し、過冷却用熱交換器３１０のバイパス側入口の温度センサ３３４によってバイパス側入口温度（このバイパス側入口を通るバイパス流冷媒の温度）Ｔｂｉを検出する。そして、バイパス側出口温度Ｔｂｏとバイパス側入口温度Ｔｂｉとの差（Ｔｂｏ－Ｔｂｉ）を算出し、この差（Ｔｂｏ－Ｔｂｉ）が所定の目標値にな

るように、バイパス電動膨張弁３１２を制御する。

【０００６】これにより、蒸発器３０５の出口を通る主流冷媒の過熱度および過冷却用熱交換器３１０のバイパス側出口を通るバイパス流冷媒の過熱度を的確に制御することができる。したがって、過冷却を行う利点を十分に生かすことができ、運転条件にかかわらず高い冷凍能力を維持することができる。

【０００７】１つの具体例として図４に示すように、上記温度差（Ｔｂｏ－Ｔｂｉ）は、主電動膨張弁３０４の開度が大きいほど大きくなり、バイパス電動膨張弁３１２の開度が大きいほど小さくなる。そして、性能ピーク点Ｐ１は、温度差（Ｔｂｏ－Ｔｂｉ）が約３℃の曲線上の点にある。また、能力およびＣＯＰが性能ピーク点Ｐ１の９９％以上になる領域Ｒ１は、性能ピーク点Ｐ１を包含する楕円領域になる。この楕円領域Ｒ１は、温度差（Ｔｂｏ－Ｔｂｉ）が３℃の曲線から１５℃の曲線に亘って存在しており、３℃～１５℃の曲線群が広がり始める辺りから主電動膨張弁３０４，バイパス電動膨張弁３１２共に開く方向に延在している。

【０００８】

【発明が解決しようとする課題】ところで、上記従来例では、過冷却用熱交換器３１０のバイパス側入口と出口に温度センサ３３４と３３５が必要になるため、コストアップになるという問題がある。

【０００９】そこで、この発明の目的は、コストを抑えながら、バイパス流冷媒の過熱度を的確に制御できる空気調和機を提供することにある。

【００１０】

【課題を解決するための手段】本発明の発明者等は、図２に示すように、バイパス側出口温度Ｔｂｏと蒸発器入口温度Ｔｅとの差(Ｔｂｏ－Ｔｅ)が３℃，４℃，６℃，８℃，１０℃，１５℃となる曲線は、それぞれ、上記温度差(Ｔｂｏ－Ｔｂｉ)が３℃，４℃，６℃，８℃，１０℃，１５℃となる曲線に近接していることを発見した。特に、上記温度差(Ｔｂｏ－Ｔｂｉ)が３℃より大きくなるほど、図４の曲線群は図２の曲線群に接近し、上記温度差が８℃以上では両曲線群が略一致することを見出した。このことから、発明者等は、蒸発器入口での冷媒温度Ｔｅと過冷却用熱交換器の出口での冷媒温度Ｔｂｏとに基づいて、バイパス側電動膨張弁の絞り量を調節することは、過冷却用熱交換器の入口での冷媒温度Ｔｂｉと過冷却用熱交換器の出口での冷媒温度Ｔｂｏとに基づいて、バイパス側電動膨張弁の絞り量を調節することに略等価になると考えて本発明を創作した。

【００１１】すなわち、この請求項１の発明の空気調和機は、圧縮機、凝縮器、過冷却用熱交換器、主電動膨張弁および蒸発器の順に冷媒を流す主回路と、上記凝縮器と主電動膨張弁との間で上記主回路から分岐して、バイパス側電動膨張弁、上記過冷却用熱交換器の順に冷媒を流し、上記圧縮機の吸入側で上記主回路と合流するバイパス回路とを有する冷媒回路を備えて、上記主回路を流れる主流冷媒と、上記バイパス回路を流れるバイパス流冷媒との間で熱交換を行って、上記主流冷媒を過冷却する空気調和機であって、上記蒸発器入口での冷媒温度と上記過冷却用熱交換器の出口での冷媒温度とに基づいて、上記バイパス側電動膨張弁の絞り量を調節して、上記過冷却用熱交換器のバイパス側出口の過熱度を、目標過熱度にする過熱度制御部を備えたことを特徴としている。

【００１２】この請求項１の発明では、過熱度制御部は、蒸発器入口での冷媒温度と過冷却用熱交換器の出口での冷媒温度とに基づいて、バイパス側電動膨張弁の絞り量を調節して、過冷却用熱交換器のバイパス側出口の過熱度を目標過熱度にする。したがって、この発明によれば、過冷却用熱交換器の入口に温度センサを設置する必要は無く、過冷却用熱交換器の出口に温度センサを設け、蒸発器入口での冷媒温度は、空気調和機の各種運転状態の検出，制御に使用される温度センサを流用して検出できる。したがって、請求項１の発明によれば、従来必要であった過冷却用熱交換器の入口での温度センサが不要になるから、コストを抑えながら、バイパス流冷媒の過熱度を的確に制御できる。

【００１３】また、請求項２の発明は、請求項１に記載の空気調和機において、上記過熱度制御手段は、上記過冷却用熱交換器の出口での冷媒温度Ｔｂｏから上記蒸発器入口での冷媒温度Ｔｅを減算した温度差(Ｔｂｏ－Ｔｅ)が所定の目標値になるように、上記バイパス側電動膨張弁の絞り量を調節することを特徴としている。

【００１４】この請求項２の発明では、過熱度制御手段は、バイパス側電動膨張弁の絞り量を調節して、温度差(Ｔｂｏ－Ｔｅ)を所定の目標値にする。前述のように、能力，ＣＯＰがピーク点の９９％以上の領域と温度差(Ｔｂｏ－Ｔｅ)との関係は、能力，ＣＯＰがピーク点の９９％以上の領域と温度差(Ｔｂｏ－Ｔｂi)との関係と略等しい。

【００１５】したがって、この請求項２の発明によれば、バイパス側電動膨張弁の絞り量を設定する基準に温度差(Ｔｂｏ－Ｔｅ)を採用することで、過冷却用熱交換器の入口に温度センサを設置せずにコスト上昇を抑えつつ、バイパス流冷媒の過熱度を従来と同様に的確に制御できる。

【００１６】また、請求項３の発明は、請求項１に記載の空気調和機において、上記過熱度制御手段は、上記蒸発器入口での冷媒温度に一定値を加算した値が上記過冷却用熱交換器の出口での冷媒温度になるように、上記バイパス側電動膨張弁の絞り量を調節することを特徴としている。

【００１７】この請求項３の発明では、過熱度制御手段は、バイパス側電動膨張弁の絞り量を調節して、過冷却用熱交換器の出口での冷媒温度を蒸発器入口での冷媒温

度に一定値を加算した値にする。これにより、能力，ＣＯＰを性能ピーク点に近づけて、能力とＣＯＰの向上を図れる。

【００１８】また、請求項４の発明では、請求項１乃至３のいずれか1つに記載の空気調和機において、冷房時には、室外熱交換器からの冷媒を、順次、過冷却用熱交換器、主電動膨張弁、室内熱交換器に流す一方、暖房時には、室内熱交換器からの冷媒を、順次、過冷却用熱交換器、主電動膨張弁、室外熱交換器に流す逆止弁ブリッジ整流回路を備えたことを特徴としている。

【００１９】この請求項４の発明では、上記整流回路によって、冷房時には、室外熱交換器からの冷媒を、過冷却用熱交換器、主電動膨張弁、室内熱交換器の順に流す。一方、暖房時には、上記整流回路は、室内熱交換器からの冷媒を、過冷却用熱交換器、主電動膨張弁、室外熱交換器の順に流す。したがって、この請求項４の発明によれば、冷房と暖房の両方において、過冷却用熱交換器を働かして、能力とＣＯＰの向上を図れる。

【００２０】

【発明の実施の形態】以下、この発明を図示の実施の形態により詳細に説明する。

【００２１】図１に、この発明の空気調和機の実施の形態の回路を示す。この実施形態は、圧縮機１と、この圧縮機１の吐出側に接続された4路切替弁２と、この４路切替弁２の口２ａにヘッダー３ａが接続された室外熱交換器３と、この室外熱交換器３の分流器３ｂに接続された逆止弁ブリッジ５を有する。この逆止弁ブリッジ５は、閉ループ接続された４つの逆止弁２１，２２，２３，２４で構成されている。

【００２２】この逆止弁ブリッジ５の端子５ａは、迂回配管４によって、レシーバ６を経由し、室外熱交換器３内を貫通してからＵターンして再び室外熱交換器３を貫通し、過冷却熱交換器７の主流側入口７ａに接続されている。冷媒を、迂回配管４でもって、過冷却熱交換器７の前で、レシーバ６，室外熱交換器３を通過させるのは、過冷却熱交換器７の前で冷媒をシール(密封)するためである。

【００２３】そして、上記逆止弁ブリッジ５の端子５ａを過冷却熱交換器７の主流側入口７ａに接続する配管８には、上記主流側入口７ａの手前で分岐する分岐配管１０が接続されている。この分岐配管１０は、バイパス側電動膨張弁１１を経由して、過冷却熱交換器７のバイパス側入口７ｂに接続されている。また、この過冷却熱交換器７のバイパス側出口７ｃは、配管１３で、アキュムレータ１２を経由して、圧縮機１の吸入側に接続されている。この配管１３には、上記アキュムレータ１２の手前で配管１５が接続されており、この配管１５は、４路切替弁２の口２ｂに接続されている。

【００２４】一方、上記過冷却熱交換器７の主流側出口７ｄは、メイン電動膨張弁１６に接続され、このメイン

電動膨張弁１６は、逆止弁ブリッジ５の端子５ｂに接続されている。そして、この逆止弁ブリッジ５の端子５ｃは、室内熱交換器１７の分流器１７ａに接続されている。この室内熱交換器１７のヘッダー１７ｂは、４路切替弁２の口２ｃに接続されている。

【００２５】また、この空気調和機は、室内熱交換器１７の分流器１７ａに、温度センサ３１が取り付けられている。また、室外熱交換器３の分流器３ｂに、温度センサ３２が取り付けられている。温度センサ３１，３２からの信号は、演算部３３に送られる。この演算部３３は、温度センサ３１が検出した温度Ｔｅに所定温度αを加算した値(Ｔｅ＋α)を、過冷却熱交換器７のバイパス側出口７ｃでの冷媒温度Ｔｂｏの目標値Ｔｂｏｏとして、第２比較部３５に出力する。この第２比較部３５は、過冷却熱交換器７のバイパス側出口７ｃに取り付けられた温度センサ３３から送られてきた信号が表す温度Ｔｂｏと目標値Ｔｂｏｏとを比較し、測定温度Ｔｂｏが目標値Ｔｂｏｏになるようなバイパス電動膨張弁１１の開度を表す信号を第２操作部３６に送出する。この第２操作部３６は、上記開度を表す信号にしたがって、バイパス側電動膨張弁１１の開度を調節する。

【００２６】さらに、上記演算部３３は、温度センサ３１からの温度Ｔｅを表す信号と温度センサ３２からの温度Ｔｃを表す信号とから、圧縮機１の吐出管温度Ｔｄの目標値Ｔｄｏを演算して、第１比較部４１に出力する。この第１比較部４１は、圧縮機１の吐出管に取り付けられた温度センサ４２からの吐出管温度Ｔｄを表す信号を受け、上記目標値Ｔｄｏと実際の吐出管温度Ｔｄとを比較し、この比較した結果を第１操作部４３に出力する。この第１操作部４３は、上記比較結果に基づいて、吐出管温度Ｔｄが目標値Ｔｄｏになるように、メイン電動膨張弁１６の開度を調節する。

【００２７】上記構成の空気調和機は、４路切替弁２が図１に示す実線経路を連通させているときに、冷房運転を行う。この冷房運転では、圧縮機１が吐出した冷媒は、室外熱交換器３に送出され、この室外熱交換器３で凝縮される。この凝縮された冷媒は、逆止弁ブリッジ５の逆止弁２１を通って、レシーバ６，室外熱交換器３を通過し、配管８を通って、過冷却熱交換器７の主流側入口７ａに流入する。この過冷却熱交換器７に流入した主流冷媒は、分岐配管１０で主流から分岐してバイパス側電動膨張弁１１で膨張して冷えた冷媒と熱交換して冷やされる。次に、この冷やされた主流冷媒は、メイン電動膨張弁１６で膨張して冷えてから、逆止弁ブリッジ５の逆止弁２３を通って、室内熱交換器１７に流入する。この室内熱交換器１７に流入した冷媒は、蒸発すると同時に室内空気を冷却し、４路切替弁２を通って、配管１５を通って配管１３のバイパス冷媒流に合流し、圧縮機１の吸入側に流入する。

【００２８】一方、４路切替弁２が図１に示す破線経路

を連通させているときには、この空気調和機は暖房運転を行う。この暖房運転では、圧縮機１が吐出した冷媒は、室内熱交換器１７に送出され、この室内熱交換器１７で凝縮され、室内に放熱する。この凝縮された冷媒は、逆止弁ブリッジ５の逆止弁２４を通って、レシーバ６，室外熱交換器３を通過し、配管８を通って、過冷却熱交換器７の主流側入口７ａに流入する。この過冷却熱交換器７に流入した主流冷媒は、分岐配管１０で主流から分岐してバイパス側電動膨張弁１１で膨張した冷媒と熱交換して冷やされる。次に、この冷やされた主流冷媒は、メイン電動膨張弁１６で膨張して冷えてから、逆止弁ブリッジ５の逆止弁２２を通って、室外熱交換器３に流入する。この室外熱交換器３に流入した冷媒は、吸熱して蒸発し、４路切替弁２と配管１５を通って配管１３のバイパス冷媒流に合流し、圧縮機１の吸入側に流入する。

【００２９】このように、この実施形態によれば、冷房時にも暖房時にも、逆止弁ブリッジ５の働きでもって、凝縮器としての室外熱交換器３もしくは室内熱交換器１７から過冷却熱交換器７，メイン電動膨張弁１６の順に冷媒を流して過冷却熱交換器７を働かし、能力とＣＯＰを向上できる。

【００３０】また、この実施形態によれば、冷房時には、蒸発器として働く室内熱交換器１７の入口に設置された温度センサ３１が検出した温度Ｔｅに所定温度αを加算した値(Ｔｅ＋α)を、過冷却熱交換器７のバイパス側出口７ｃでの冷媒温度Ｔｂｏの目標値Ｔｂｏｏにした。そして、過冷却熱交換器７のバイパス側出口７ｃに取り付けられた温度センサ３３が検出した冷媒温度Ｔｂｏを、この目標値Ｔｂｏｏにするように、バイパス側電動膨張弁１１の開度を調節する。

【００３１】一方、暖房時には、蒸発器として働く室外熱交換器３の入口に設置された温度センサ３２が検出した温度Ｔｃに所定温度βを加算した値(Ｔｃ＋β)を、過冷却熱交換器７のバイパス側出口７ｃでの冷媒温度Ｔｂの目標値Ｔｂｏｏにした。そして、過冷却熱交換器７のバイパス側出口７ｃに取り付けられた温度センサ３３が検出した冷媒温度Ｔｂｏを、この目標値Ｔｂｏｏにするように、バイパス側電動膨張弁１１の開度を調節する。

【００３２】このような過冷却制御によれば、従来必要であった過冷却用熱交換器７の入口の温度センサが不要になるから、コストを抑えながら、バイパス流冷媒の過熱度を的確に制御でき、能力とＣＯＰの向上を図ることができる。

【００３３】次に、図３のモリエル線図に、室内熱交換器１７と室外熱交換器３との間の連絡配管５１，５２が長い(２０ｍ)場合の冷媒状態を実線で示し、上記連絡配管５１，５２が短い(５ｍ)場合の冷媒状態を破線で示す。図３を参照すれば分かるように、５ｍ配管の場合のバイパス側出口７ｃでの冷媒温度Ｔｂｏ(５ｍ)は、２０ｍ配管の場合のバイパス側出口７ｃでの冷媒温度Ｔｂｏ(２０ｍ)に比べて高い。そして、冷媒温度Ｔｂｏ(２０ｍ)は、冷媒温度Ｔｂｏ(５ｍ)よりも室内熱交換器１７の入口での冷媒温度Ｔｅに近い。

【００３４】したがって、５ｍ配管の冷媒回路において冷媒温度Ｔｂｏ(５ｍ)の目標値Ｔｂｏｏが(Ｔｅ＋α)に設定されている状態で、連絡配管を２０ｍ配管に変更すると、冷媒温度Ｔｂｏは低下する。別の見方をすれば、５ｍ配管を２０ｍ配管に変更すると、５ｍ配管において目標値Ｔｂｏｏを上昇させたときと同じように、バイパス電動膨張弁１１が閉じる方向にシフトする。その結果、バイパス側出口７ｃでの過熱がつく方向にシフトすることになり、図２に示す性能,ＣＯＰが最大値の９９％の領域Ｒ１から逸脱し難い。何故ならば、図２に示すように、過熱が付く方向への温度勾配は険しくなっている(等温線が混んでいる)からである。しかも、冷媒温度Ｔｂｏ(５ｍ)と冷媒温度Ｔｂｏ(２０ｍ)との差は、２℃程度で比較的小さいから、膨張弁開度制御に与える影響はほとんどない。なお、実用上は、図２に例示した性能ピーク点Ｐ１よりも幾分過熱側(すなわち、温度差(Ｔｂｏ－Ｔｅ)が高温側(例えば４℃))に設定する。図２に示すように、温度差(Ｔｂｏ－Ｔｅ)が８℃や１０℃になっても、性能ピーク点Ｐ１からの性能低下はわずか(１％以内)である。

【００３５】尚、上記実施の形態では、Ｔｂｏを(Ｔｅ＋所定値α)＝Ｔｂｏｏにするように、制御したが、(Ｔｂｏ－Ｔｅ)が所定値になるように制御してもよい。

【００３６】

【発明の効果】以上より明らかなように、この請求項１の発明の空気調和機では、過熱度制御部は、蒸発器入口での冷媒温度と過冷却用熱交換器の出口での冷媒温度とに基づいて、バイパス側電動膨張弁の絞り量を調節して、過冷却用熱交換器のバイパス側出口の過熱度を目標過熱度にする。したがって、この発明によれば、過冷却用熱交換器の入口に温度センサを設置する必要は無く、過冷却用熱交換器の出口に温度センサを設け、蒸発器入口での冷媒温度は、空気調和機の各種運転状態の検出，制御に使用される温度センサを流用して検出できる。したがって、請求項１の発明によれば、従来必要であった過冷却用熱交換器の入口での温度センサが不要になるから、コストを抑えながら、バイパス流冷媒の過熱度を的確に制御できる。

【００３７】また、請求項２の発明では、過熱度制御手段は、バイパス側電動膨張弁の絞り量を調節して、温度差(Ｔｂｏ－Ｔｅ)を所定の目標値にする。前述のように、能力,ＣＯＰがピーク点の９９％以上の領域と温度差(Ｔｂｏ－Ｔｅ)との関係は、能力,ＣＯＰがピーク点の９９％以上の領域と温度差(Ｔｂｏ－Ｔｂｉ)との関係と略等しい。したがって、この請求項２の発明によれば、バイパス側電動膨張弁の絞り量を設定する基準に温

度差（Ｔｂｏ－Ｔｅ）を採用することで、過冷却用熱交換器の入口に温度センサを設置せずにコスト上昇を抑えつつ、バイパス流冷媒の過熱度を従来と同様に的確に制御できる。

【００３８】また、請求項３の発明では、過熱度制御手段は、バイパス側電動膨張弁の絞り量を調節して、過冷却用熱交換器の出口での冷媒温度を蒸発器入口での冷媒温度に一定値を加算した値にする。これにより、能力，ＣＯＰを性能ピーク点に近づけて、能力とＣＯＰの向上を図れる。

【００３９】また、請求項４の発明では、逆止弁ブリッジ整流回路によって、冷房時には、室外熱交換器からの冷媒を、過冷却用熱交換器，主電動膨張弁，室内熱交換器の順に流す。一方、暖房時には、上記整流回路は、室内熱交換器からの冷媒を、過冷却用熱交換器，主電動膨張弁，室外熱交換器の順に流す。したがって、この請求項４の発明によれば、冷房と暖房の両方において、過冷却用熱交換器を働かして、能力とＣＯＰの向上を図れる。

【図面の簡単な説明】

【図１】　この発明の空気調和機の実施の形態の構成を示すブロック図である。

【図２】　上記実施の形態において、メイン電動膨張弁，バイパス側電動膨張弁の開度と過冷却熱交換器の過熱度（Ｔｂｏ－Ｔｅ）との関係を示す特性図である。

【図３】　上記実施の形態の動作を説明するモリエル線図である。

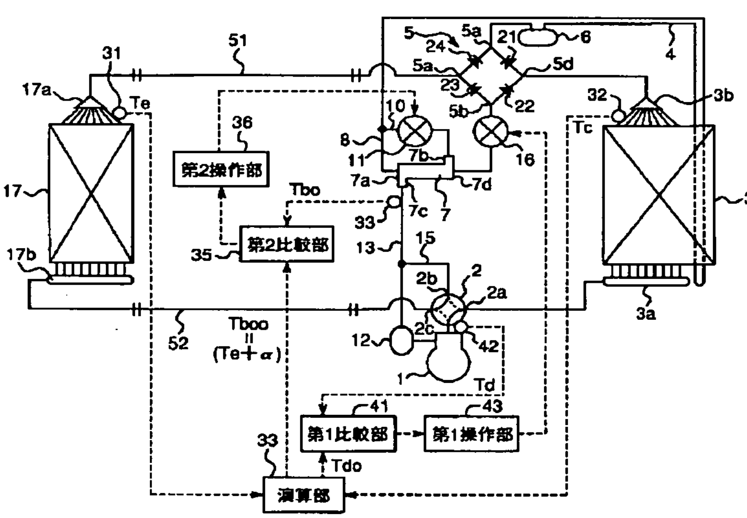
【図４】　上記実施の形態において、メイン電動膨張弁，バイパス側電動膨張弁の開度と過冷却熱交換器の過熱度（Ｔｂｏ－Ｔｂｉ）との関係を示す特性図である。

【図５】　従来の空気調和機の冷媒回路図である。図である。

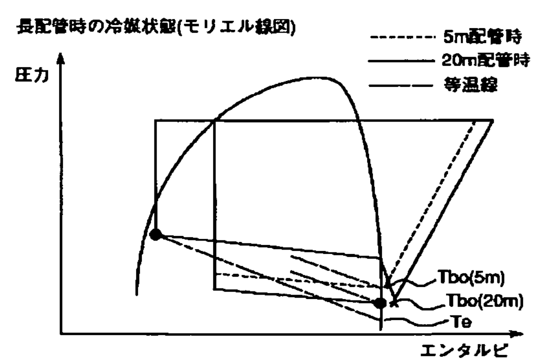
【符号の説明】

１…圧縮機、２…4路切替弁、３…室外熱交換器、３ａ…分流器、３ｂ…ヘッダー、５…逆止弁ブリッジ、６…レシーバ、７…過冷却熱交換器、７ａ…主流側入口、７ｂ…バイパス側入口、７ｃ…バイパス側出口、７ｄ…主流側出口、１１…バイパス側電動膨張弁、１６…メイン電動膨張弁、１７…室内熱交換器、３１，３２，３３，３４…温度センサ。

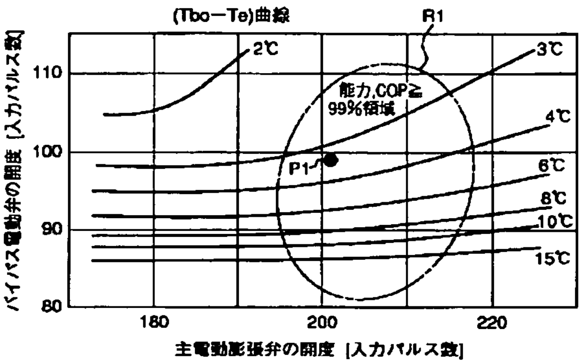
【図１】



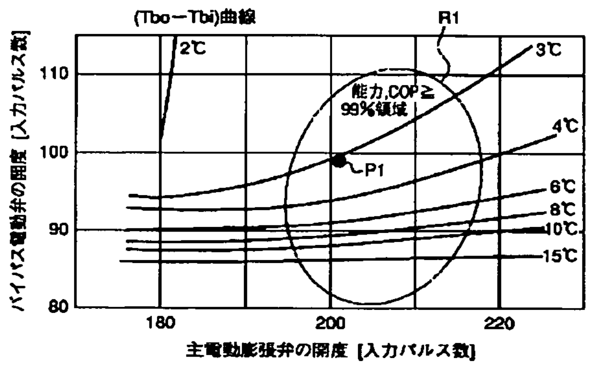
【図３】



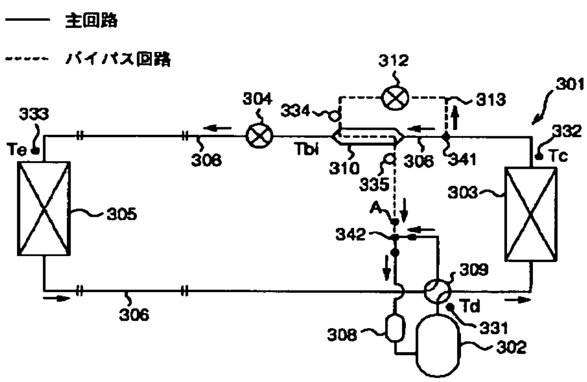
【図２】


(Tbo－Te)曲線
R1
2℃
3℃
4℃
6℃
8℃
10℃
15℃
能力,COP≧
99%領域
P1
110
100
90
80
180
200
220
バイパス電動弁の開度 [入力パルス数]
主電動膨張弁の開度 [入力パルス数]

【図４】


(Tbo－Tbi)曲線
R1
2℃
3℃
4℃
6℃
8℃
10℃
15℃
能力,COP≧
99%領域
P1
110
100
90
80
180
200
220
バイパス電動弁の開度 [入力パルス数]
主電動膨張弁の開度 [入力パルス数]

【図５】


主回路
バイパス回路
312
313
301
304
334
333
332
Te
Tbi
Tc
306
310
306
341
335
303
305
A
342
309
Td
331
306
308
302